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The Orang-utan in Sarawak

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(Text-figure 1)

Although numerous naturalists and collectors have visited Borneo and Sumatra in the past hundred years, the orang-utan (*Pongo pygmaeus*) remains the least known of the great apes. No detailed reports on the status and distribution of this animal have ever been published for Borneo as a whole. Stott & Selsor (1961) present the only recent information for the British colony of North Borneo. For Sumatra, Carpenter (1938) furnishes the sole account. Data on the ecology and behavior of free-living orang-utans are based primarily on the sporadic observations of Schlegel & Müller (1839-44), quoted in Yerkes & Yerkes (1929), Wallace (1869), Hornaday (1885), and Beccari (1904). Yerkes & Yerkes (1929) summarize the available information and no major references can be added.

The reported rapid decline in the orang-utan population of Sarawak in recent years has focused the attention of conservationists on this small British colony in the northwestern corner of Borneo. In order to determine the present status of the orang-utan, or *maias* as the animal is called locally, I visited Sarawak from November 7, 1960, until January 2, 1961. This report presents my findings as well as pertinent notes on the ecology and behavior.

Acknowledgements

The study was conducted under a grant from the National Science Foundation and the New York Zoological Society, and the latter institution also acted as sponsor. The Sarawak Museum was the local sponsor. Dr. John T. Emlen, University of Wisconsin, and Mr. Harold J. Coolidge, National Academy of Sciences, helped with planning and guidance of the expedition. In Sarawak, Mr. Tom Harrisson, the curator of the Sarawak Museum, aided with logistic and other support, as did Mr. B. E. Smythies, the conservator of forests. Mr. J. A. R. Anderson, forest research officer, identified the food plants. Mrs. Barbara Harrisson offered her hospitality and her information of captive orang-utan infants. Mr. Gaun anak Sureng, an Iban working for the Sarawak Museum, was invaluable in the field. Mr. John E. Dallman, University of Wisconsin, prepared the map. To all these institutions and people I am deeply grateful.

Valuable comments on the manuscript were made by Dr. John T. Emlen, Mr. Harold J. Coolidge and Mr. B. E. Smythies.

Procedure and Methods

The data on the distribution and status are based on personal observations, and on information in the files of the Sarawak Forest Department. Extensive foot and boat transects were made in two of the three accessible major forest tracts still inhabited by orang-utans, and the forest areas immediately surrounding these tracts were also visited. Transects were conducted in all major types of orang-utan habitat and the status of the animal evaluated by means of a crude index based on the number of nests seen and the number of hours walked.

In 1959 all section forest officers were asked by the Forest Department to collect information about the orang-utan in their area. In addition, Mr. Gaun anak Sureng made a survey from May 3 to June 22, 1959, in a region later visited by myself. The governor appointed in 1959 a Maias Protection Commission headed by Mr. D. L. Bruen to ascertain the status of the animal in the colony. The distributional data of the various inquiries are incorporated in this report. Information was also collected from Dayak hunt-

ers by asking them about local conditions. Their information, whenever checked, was correct.

Most behavior data are based on personal observation; information from natives is not necessarily reliable. Orang-utans were watched quietly and alone until they detected me.

Past Distribution

Detailed knowledge about the interior of Sarawak is not available prior to the landing of James Brooke in 1839. There is, however, little doubt that in prehistoric and more recent times the orang-utan was distributed more extensively than at present. At the Niah caves, for example, excavations revealed numerous orang-utan remains in all layers below the Neolithic into the middle Paleolithic (von Koenigswald, 1958). Today no orang-utans occur within about 130 miles of the caves. Beccari (1904) mentions that rare stragglers appear at times in the Sarawak River valley southwest of Kuching. A few animals are supposed to exist in the headwaters of the Batang Undup River, a tributary to the Batang Lupar, according to Forestry Department files. In view of the extensive cultivation and almost complete destruction of primary forest it is doubtful if animals survive in the area today. Until 100 years ago a population is said to have existed near Binatang on the lower Rajang River, but the area was heavily settled by Dayaks and Chinese between 1861 and 1870 (Harrisson, 1949). A few orang-utans may, however, have persisted until recently. In 1956 a local forester received a report of two animals at Ulu Sungei Daro near Binatang. The Maias Protection Commission notes records from Ulu Sungei Pasin in the Sarikei district and from Sungei Assan and Sungei Naman southeast of Sibu near the Rajang River. Today the area has become so heavily populated that the records probably belong in the category of past distribution.

Present Geographical Distribution

Today orang-utans inhabit only a fraction of the 47,500 square miles that comprise Sarawak. The only known concentration occurs in some forests of western Sarawak between the Sadong and Batang Lupar rivers, an area of about 1,600 square miles bordered on the south by Indonesian Borneo. Cultivation, mainly along the larger rivers and in the well-drained uplands, has elim-



Text-fig. 1. Geographic distribution of the orang-utan in Sarawak. The three black areas indicate forest reserves which are known to harbor orang-utans. Dots and crosses indicate definite records outside the reserves, the former noted by the Forest Department and the latter by myself. Numbers within a circle represent records of stragglers or local populations of unknown size.

Table I. Distribution of Orang-utans Outside the Main Area of Concentration

Location	Source	Estimate of Numbers
1. Upper Ulu Ai area	Forest Dept.	About 100 (1 and 2)
2. Sungei Katibas area	Forest Dept.	
Between Sungai Knowit and Katibas	Forest Dept.	1 infant collected (1956)
3. Between Ulu Batang Balui and Ulu Batang Baleh near border	Forest Dept.	10-20
4. Sungei Pila, Mengiong Forest Reserve (Sungei Mengiong south of Batang Baleh)	Forest Dept.	Less than 20
5. Sungei Baram near Long Moh	Forest Dept.	1 male shot (1958)
6. Border region near Lubok Antu	Maias Protection Commission	—

inated over 600 square miles of forest in that area. Two hundred and ninety square miles are set aside as forest reserves. The map (Text-fig. 1) indicates the forest reserves, which harbor a sparse but continuous population of orang-utans. Records from within the past two years outside the reserves are indicated by dots and crosses. Reports of isolated populations and stragglers from areas not visited during the study are listed in Table I.[1] The numbers correspond to those on the map. Locations 3 and 4 appear to represent populations of unknown size in the border hills between Sarawak and Indonesian Borneo. Location 5 is a straggler, for orang-utans are unknown to the natives of the area (Smythies, pers. comm.). But the whole border region is nearly uninhabited and seldom penetrated, and it is possible that orang-utans occur sparsely along the whole range between locations 4 and 5. Locations 1 and 2 are included in the 625 square mile Lanjak-Entimau forest reserve, which is surrounded by shifting cultivation. Location 6 apparently represents a scattered remnant in an area greatly disturbed by agriculture.

The only other distributional data come from infant orang-utans captured by Dayaks and confiscated by the government. Some of these records are unreliable, because infants are smuggled over from Indonesian Borneo, and confiscations are usually made in or near towns. Thus, there are records from Lundu, Sibu and Bau near Kuching, regions from which there are no recent records of free-living animals.

Numerical Status

Although no population estimates are available prior to 1959, it is apparent from the earlier literature that orang-utans have declined drastically in the past hundred years. Hornaday (1885) not infrequently encountered animals twice in the same day while traveling along rivers on which I saw only scattered nests during the present study. Beccari (1904) noted a total of eight orang-utans in three separate encounters in one day while walking in the forest near the Batang Lupar River. In 1960 I observed animals on the average of only once a week.

This population decline is not surprising in view of the hunting pressure to which the orang-utan has been subjected. James Brooke (1848) in 1840, for example, collected four animals during one days' outing. Wallace (1869) shot or captured 17, Hornaday (1885) 43, and Beccari (1904) 24. All these animals were collected between the Sadong and Batang Lupar rivers. In addition, numerous zoo collectors left with one or more infants, only obtained by shooting the mother. This slaughter continued until 1947 when the orang-utan became legally protected in Sarawak.

Data on comparison of population levels in different parts of the range were essayed by indices based on the number of nests encountered divided by the number of hours walked. The most intensive transects were conducted in the lowland and hill forests of the 106.5 square miles of the Sabal and Balai Ringin reserves adjoining

[1] It was not possible, in the short time available, to check the accuracy of the various reports about isolated populations and stragglers. Sarawak lacks roads and most travel is by river, a time-consuming and expensive undertaking if uninhabited country is to be visited. Unknown territory along the Indonesian border is so extensive that censuses would require at least 6 months. Thus, the only records available are the scanty ones by forestry officers, which undoubtedly are second-hand for the most part.

the Indonesian border. In the former 4.3 (1.4-8.0) nests per hour were recorded; in the latter 1.7 (0-3.2) nests. Going on the assumptions that my rate of walking is one mile per hour, that orang-utans build one nest per day, that all nests are counted in a 200-foot wide strip, and that nests remain clearly visible for six months, a total population of 36 independent animals was derived for the two reserves. This figure could perhaps be raised to 40 or 45 if infants are included. Assuming that a rough density of one animal per two square miles is typical, a population of only 150 orang-utans would appear to inhabit the 290 square miles of forest reserves between the Sadong and Batang Lupar rivers. The remaining forests surrounding the reserves have been extensively disturbed and patches have been isolated by clearing and logging. Small, scattered populations persist, however, and if transect data in three locations are representative, an additional 200 animals could perhaps be added, bringing the number between the Sadong and Batang Lupar rivers to 350. This estimate agrees closely with that of Smythies (1960) who writes: "The only concentration of *maias* appears to be in the swamps between the Sadong and Batang Lupar (even here it is doubtful whether there are more than 200-300 left), and south of the Serian-Simanggang Road in the Balai Ringin and Sabal Forest Reserves."

A population estimate for the whole of Sarawak is entirely conjectural in view of the paucity of distributional records in the unknown border regions. It can, however, be safely said that the total population is not less than 450 animals and probably not more than 700.

Ecological Distribution

Orang-utans are animals of primary equatorial rain forest and as such their habitat shows little ecological diversity. Much of their habitat in Sarawak lies below an altitude of 500 feet in the swampy forests bordering the coast and the major streams. To the south the land rises and becomes gently rolling, interrupted here and there by prominent hills. Along the Indonesian border of western Sarawak mountains reach a height of 3,000 feet. Above that altitude the trees become more stunted. Banks (1931) notes that the upper limit of orang-utan distribution over most of their range appears to be 3,000 feet, although he mentions a record from as high as 6,000 feet on Mount Kinabalu in North Borneo.

Climatically Sarawak is characterized by rainfall of 120 to 160 inches per year, and uniform high temperatures (72 to 88°F at mean sea level) and humidity (98% mean relative humidity at 0600). Rain falls during all months of the year, but is heaviest from October to February (Seal, 1958). In keeping with the climate, the forests consist almost entirely of evergreen trees, probably exceeding 2,500 species in number, and covering some 75 per cent. of Sarawak. Several types of forest can be distinguished. Those inhabited by orang-utans are described below. Terminology and classification follows that of Smythies (1960). No obvious habitat preference for certain types of primary forest could be detected in the orang-utan.

Peatswamp Forest—Five vegetation types are recognized by the Forest Department in the peatswamp forest of Sarawak (Smythies, in litt.), but only the mixed swamp forest type, which is by far the most prevalent, is of importance to orang-utans. Three of the forest reserves containing orang-utan (Sedilu-Sebuyau, Simunjan) are primarily of the mixed swamp forest type. Structurally this forest is typical rain forest with an upper canopy of big trees 120 to 150 feet high and several layers of poorly-defined lower-story trees. Groundcover is essentially absent and the peat is covered by water ankle to chest deep over much of the area. Except along the margins of the rivers where alluvium is present, the soil consists of over 95% organic matter in a semi-liquid, decomposed state. Drainage and irrigation are generally impracticable, and the soil is therefore of little use for agricultural purposes, other than the growing of sago palms. Although there are only about 200 big tree species, some of these are valuable for timber and are being extensively logged.

Heath Forest—Small stands of heath forest occur over most of Sarawak on very poor, acid podsol soils. The trees are of relatively small size, lacking for the most part the upper story trees with big trunks. This habitat is of little importance to orang-utans, for only small patches exist in their present range; one visited supported a sparse population of animals.

Riparian Forest—This type of forest, rarely half a mile wide, occurs on riverine alluvial soils. Where rivers flow rapidly *Shorea* spp. is especially prominent; along slow-moving streams the valuable timber tree *Eusideroxylon zwageri* becomes important. Because the soil is rich and the forest easily logged, this habitat has for all practical purposes disappeared.

Dipterocarp Forest—This type is divided altitudinally into (a) Lowland Dipterocarp forest, (b) Hill Dipterocarp forest and (c) Moss forest. Together they still cover 28,000 square miles (59 per cent.) of Sarawak. Structurally the lowland and hill forests resemble the mixed swamp forest. Both contain some valuable timber species, and large areas, mostly of the lowland type,

are being logged. (a) The lowland forest comprises many hundred tree species dominated by such Dipterocarps as *Shorea, Dipterocarpus* and *Dryobalanops*. The topography is rolling to hilly and the ground well-drained. The soil is non-podsolic, and much is probably suitable for agriculture. Orang-utans inhabit lowland forest in the adjoining Balai Ringin and Sabal reserves, and most likely in the Lanjak-Entimau reserve and in other border forests. (b) The hill Dipterocarp forest is confined to steeply sloping, often rocky, ground at altitudes above 1,000 feet. It is similar to the lowland forest except that the number of Dipterocarp species is fewer and the amount of big timber has decreased. Some of the slopes might be suitable for agriculture. Orang-utans inhabit this type in the Sabal reserve. (c) Moss forest occurs on the mountain ridges at about 3,000 feet in the Sabal reserve. Most of the big trees are lacking; others are of small girth and rarely exceed 80 feet in height. A few nests were noted in this habitat, but on the whole it is probably too restricted to be of much importance to orang-utans.

Distributional Dynamics

Although the major portion of Sarawak is still covered by the types of forests used by orang-utans, only a small fraction of the available habitat is frequented by the animals today. This, coupled with the fact that in the past they inhabited areas not occupied now, suggests that neither topography nor habitat had been limiting factors to dispersal and to numbers before the advent of agriculture. The high mountains (to over 5,000 feet) along sections of the Sarawak-Indonesian Borneo border act undoubtedly as partial barriers to a spread to and from the west, but numerous low gaps exist which appear to have been penetrated in the past all the way to the coast. Large rivers, like the Sadong and Batang Lupar, are definite barriers to direct movement perpendicular to their flow, but most rivers follow a course which does not hinder access to and from Indonesian Borneo.

It is not improbable that hunting by man has, at least in some parts, been the major limiting factor before the expansion of agriculture. That primitive man hunted and ate orang-utans extensively is shown by the remains in the Niah caves.

In the past hundred years habitat destruction has been added to hunting as a limiting factor to dispersal in some areas, and the former has reached a stage where the orang-utan is effectively prevented from extending its range in the major area of concentration. The Sadong-Batang Lupar population is hemmed in by two large rivers and agriculture; the population in the Lanjak-Entimau forest is surrounded by shifting cultivation.

It is doubtful if the orang-utan will ever adapt to habitat other than primary forest and old secondary forest. Although the animal can survive in very lightly logged forest where the canopy is only partially broken, no sign was ever noted or records obtained from very young secondary forest or from forest so heavily disturbed by logging that large sections of the canopy have been removed. Unfortunately the area with the greatest present-day orang-utan concentration supports also a heavy human population. All marginal agricultural land will undoubtedly have been put to use within the next few years, and the remaining patches of forest will be so logged and dissected with fields as to make them unsuitable for orang-utan.

The only hope for the remaining orang-utans in Sarawak lies in the preservation of the forest reserves which still harbor animals. These reserves are at present being logged in the accessible portions. In the peatswamp forest a 60-year cycle is used; in the lowland forest a 70-year cycle. The available undisturbed habitat in the reserves appears to be still adequate to support the orang-utan population. But logging has damaged some sectors so heavily that expansion of this activity can only be detrimental to the remaining animals.

All hunting, too, must cease if the orang-utan is expected to survive. Illegal hunting for meat and infants appears to continue on a limited scale. Between 1956 and 1960 a total of 13 infants were confiscated by the government, some of which were, however, smuggled over from Indonesian Borneo.

Behavior

Orang-utans were seen four times and observed directly for 5¾ hours. Indirect data from nests were also collected.

Locomotion — The orang-utan is basically arboreal, a habitat to which it is eminently adapted, for it possesses in effect four hands with which to clasp. It apparently frequents the ground only rarely. Wallace (1869) and Shelford (1916) received information of Dayaks injured by males which were surprised on the ground, and I was several times informed that orang-utans descend to eat the fruits and shoots of the palm *Zalacca conferta* in times of food shortage.

My observations confirm those of Wallace (1869) and Hornaday (1885) that the orang-utan brachiates on occasion but that its usual mode of progression is by climbing. One subadult

was observed as it fled through the tree tops over a distance of ¼ mile. On large horizontal limbs it moved on all fours. It carefully but rapidly climbed into smaller branches, reached for and pulled in the foliage of the adjoining tree, secured a firm hold, and, with legs briefly free, swung across. Once it jumped three feet down to another branch, the only such instance noted. It also brachiated along a branch for about eight feet. The animal was greatly disturbed by my presence, and moved along at a speed of about three miles per hour, making it barely possible for me to keep up on the uneven ground.

Similar observations were made on two other orang-utans. A female with infant swung her legs free several times while holding onto a branch with her hands, primarily to reach another limb beneath her; but only once did she brachiate along a branch for about ten feet. A medium-sized male, who was followed by me for two hours, brachiated several times for distances of less than ten feet each. The rest of the time he climbed, always holding on to as many branches as possible. Twice he came to a gap in the canopy which prevented him from reaching the branches of the adjoining tree. In the first instance he inched out on a small horizontal limb until it bent under his weight, bringing him to within grasping distance of another branch. This he clutched and only when his hands were anchored securely did he release the first branch which had been retained with the feet. Another time he climbed into the crown of a vertical branch. Suddenly he threw his weight to one side, continuing his hold with one hand and foot only. The bending branch and extended arm enabled him to grasp the foliage of the next tree.

The grasping power in the feet enables the animal to hang with ease in practically any position. Hanging by one arm and foot while reaching for food is not unusual, and once a subadult hung two to three seconds by its feet alone.

Group Size and Composition—The orang-utan is the least gregarious of the apes. Whereas chimpanzees and gorillas sometimes go in groups of ten or more and gibbons and siamangs occur most frequently in groups of three to six, the orang-utan is rarely encountered in aggregations of more than two or three. Most of the records by early collectors are of single animals or groups of two. The largest aggregation noted by Brooke (1845), Wallace (1869) and Hornaday (1885) was three; by Beccari (1904) four; by Mjöberg (1930) six. Carpenter (1958) noted four, with a fifth animal in the vicinity. During the present study no single animals were seen. Three of the four encounters were of groups with two animals each, and only once did direct and indirect evidence point to a group of four animals.

Group composition varies. Lone adult males have been encountered by nearly all explorers and collectors. Although Wallace (1869) writes: "I never saw two full grown animals together . . .," other investigators have done so. Table II presents the composition of four groups as determined during this study as well as other compositions mentioned in the literature. The data show that the most frequent combinations are(1) lone males, (2) females with one or more subadults of various ages, (3) pairs, and (4) small groups of subadults.

Nothing is known about the stability of groups. Data from a group of four animals which had just moved into a section of forest suggests that groups may be quite plastic. The group consisted of a female and a small infant, which were seen, and a subadult and an adult male judging by the size of the nests and by information from natives who had encountered them. One night all four animals nested in adjoining trees; another night the female with infant and juvenile nested together, but the male slept about 400 feet away; a third night the female with infant and juvenile again nested together but there was no sign of the male in the vicinity. The female was observed that morning, but the juvenile was not with her and searching for about two hours did not reveal it.

Mother-Infant Relationship—Personal observations were made on (1) a female with small infant, and (2) a female with a semi-independent infant of about two years.

(1) A female fed in a *Durio* tree at a height of about 70 feet with the baby clinging to her side, its head just below her armpit. The arms and legs of the infant were "spidery" and with but little hair, yet it was alert and looked around. The infant began to advance across the mother's chest, and she cradled it in one arm. Restless, it clambered upward toward her shoulder, but she pulled it down. It moved up again, so the female pushed it over to its original position at her side. When it continued its wanderings, she laid it across her arm and groomed the back, using the long fingers of the same arm that held the infant. Finally she grasped a branch above her head with both hands, and the baby attached itself to her side, a place it occupied for the next hour while the female first fed and later climbed away through the trees.

(2) A female fed in one tree and her large offspring in another 50 feet away. They joined

TABLE II. COMPOSITION OF ORANG-UTAN GROUPS

Group Size	Composition	Source
1	1 young male	Wallace (1869)
1	1 adult male	Wallace (1869) Hornaday (1885) Beccari (1904)
1	1 female	Wallace (1869)
2	1 male, 1 female	Beccari (1904)
2	1 medium-sized male, 1 female	This study
2	1 female, 1 infant	Wallace (1869) Hornaday (1885)
2	1 female, 1 semi-independent infant	This study
2	2 subadults (of undetermined sex)	This study
3	3 subadults	Wallace (1869)
3	1 female, 1 subadult, 1 infant	Brooke (1848) Hornaday (1885)
3+	1 female, 2 or more subadults	Wallace (1869)
4	1 male, 1 female, 1 subadult, 1 small infant	This study
5	2 females, 2 juveniles, 1 male in the vicinity	Carpenter (1958)

and the infant sat beside its mother, one arm across her back. The infant was about five feet from her when she spotted me. Immediately she reached over and snatched the infant to her chest. As the female climbed into the next tree, it moved and held on to her back, one arm over her shoulder, the other grasping her side. The female traveled about 500 feet, stopping intermittently to look down at me. While moving the infant clung either to her back or to the side; while sitting it always stayed at the side. Although fully capable of climbing independently, the infant not once released its hold on the mother and stayed with her as she built the night nest an hour later.

Foods and Food Habits—Orang-utans are primarily frugivorous. They apparently also eat the leaves of certain trees, according to Hornaday (1885) and others, but no direct evidence for this was obtained. The shoots and fruits of the palm *Zalacca conferta* are eaten, according to the natives. One instance was noted in which an orang-utan had gnawed the inner lining of bark from a tree (probably *Ganua motleyana*) and spit out the chewed pulp. At times the animals raid cultivated fruits at the edge of the forest. Perhaps insects and other animal foods are sometimes eaten. Ryhiner (1958) observed an orang-utan "occasionally catching an insect on the bark." Mrs. Harrisson (pers. comm.) maintains that they eat the eggs of birds in the wild.

Table III presents a list of forest trees which produce fruits eaten by orang-utans. Information on food habits was supplied by natives and was reliable in the three cases when I was able to check it. Many of the fruits listed are eaten also by man, *Hylobates moloch* and various monkeys. Hornaday (1885) confirms that orang-utans eat the cultivated *Durio* and *Nephelium*.

Animals were feeding when observed at 0845, 1100, and 1625. A male and female fed quietly on the small olive-sized fruits of *Calophyllum*. The only sound was the steady patter as seeds rained on the leaves below—a sound which first attracted attention to the animals. They plucked several fruits in a row by pulling them off between thumb and index finger; they then popped them all into the mouth, chewed, and ejected the seeds through pursed lips. Similar behavior was noted in a female and large infant, except that the whole of the small fruit of *Grewia* was eaten. Feeding ceased as soon as the animals saw me.

A female with small infant, on the other hand, continued to feed in spite of my presence from 0845 to 1005 on the muskmelon-sized fruit of the durian (*Durio carinatus*). She had nested during the night in the adjoining tree, and was feeding when first found. The spiny durian fruits were plucked by hand, usually one at a time. Once she put her mouth close to a durian, tapped the back of the fruit with one hand and at the same time grabbed it between her teeth and detached it by jerking her head back. Three times fruit were transported to another branch as far as 20 feet away. Twice one was carried in the mouth, and a third time one was held in the mouth and another with one foot. When eating she held them lengthwise in the long hand and rapidly bit off chunks of tough outer skin. The soft pulp was also discarded. Apparently only

Table III. Fruits Eaten by Orang-utan

Forest Type	Species
Cultivated fruits	*Durio zibethinus* *Nephelium lappaceum* *Artocarpus* spp.
Peatswamp forest	*Pongamia*, probably *P. pinnata* *Polyalthia* sp. *Quercus* sp. *Pometia pinnata* **Durio carinatus* *Nephelium melanomisoum* (?) *Copaifera palustris*
Heath forest	*Sandoricum*, probably *S. emarginatum* *Mangifera*, probably *M. havilandii*
Lowland Dipterocarp forest	*Diospyros maingayi* *Garcinia* sp. *Quercus* sp. **Grewia* sp. *Sandoricum* sp. *Nephelium* sp. *Durio* sp.
Hill Dipterocarp forest	**Calophyllum* cf. *retusum*

* Indicates direct observation of feeding.

the pecan-sized seeds were eaten, of which each durian contains about ten. During the time of observation the female consumed the seeds of at least 15 durian, wasting only half of one seed.

Nests and Nesting Habits—Orang-utans build nests when wounded (Brooke, 1848; Wallace, 1869), in the evening before going to sleep and perhaps during the day when resting. St. John (1862) and Wallace (1869) mention that orang-utans hide in nests when pursued. No detailed accounts of orang-utan nests have been published. Hornaday (1885) briefly and erroneously writes: "The nest of the orang-utan is simply a lot of small green boughs and twigs broken off by the animal, and piled loosely in the fork of a tree . . .," and Wallace (1869) and Beccari (1904) make essentially similar statements.

Nests may be placed anywhere in a tree as long as there is sufficient support and a suitable quantity of small branches from which to construct a stable platform. The 228 nests observed in this study were found in forks made by the main trunk and smaller limbs, in the forks at the extremity of the larger limbs, along one or more horizontal branches, in the crowns and even between two close trees. Thirteen nests were examined in detail. The basic platform was constructed of three to nine (mean 4.7) major branches broken in toward the animal. They were laid across each other without pattern or interweaving. Of 62 branches used in nest construction, only seven were completely detached.

Most nests have a lining of small twigs about one foot in length, which the animal breaks off around the nest. In one instance the twigs were collected seven feet below the nest. The broken ends usually face outward, but in some nests they appear to be placed at random. The number of twigs in each nest varied from 0 to 34 (mean 10.0).

The height of nests above ground is given by Wallace (1869) as 20 to 50 feet; Hornaday (1885) 15 to 40 feet; Banks (1931) 30 feet; and other authors quote similar heights. The heights of 228 nests in mixed swamp, lowland and hill forests was either estimated or determined with a camera range finder. The results are summarized in Table IV.

From Table IV it is evident that the majority of nests (82.3 per cent.) occur between 31 and 70 feet; in other words, in the middle of the lower story trees. However, a few nests are located in the lowest story and in the tops of the emergent trees. There are no records of nests on the ground.

TABLE IV. HEIGHT OF ORANG-UTAN NESTS ABOVE GROUND

Height of nest (in feet)	Number of nests	Percent
0-10	0	.0
11-20	2	.8
21-30	5	2.2
31-40	35	15.3
41-50	57	25.0
51-60	56	24.5
61-70	39	17.5
71-80	14	6.1
81-90	6	2.6
91-100	7	3.0
101-110	1	.4
111-120	5	2.2
121-130	1	.4
Total	228	100.0

Wallace (1869), Hornaday (1885) and others have described the building of nests in free-living orang-utans. The amount of time spent in construction and the elaborateness of the nest depends probably on the weather conditions and general disposition of the animal. Nest building was observed once when an agitated female built a nest up 120 feet during a downpour at 1730. She squatted in a fork among the smaller branches. With one hand she broke in a limb, pushed it under foot while reaching for the next one with the other hand. The latter as well as a third branch were also placed beneath her feet. She paused briefly, then tore off a final branch and laid it across the others. The time required for building this crude nest was approximately 10 seconds.

Reaction to Man—Orang-utans usually avoid contact with man, but in areas where primary forest adjoins cultivation and the animals are not hunted, they may become used to the noisy presence of Dayaks working in their fields.

The reactions of orang-utans to me standing beneath their tree varied. On the one end of the scale were two subadults who fled soundlessly and as rapidly as possible; on the other a female with small infant who, except for brief glances, ignored me while feeding and finally moved off at a leisurely pace, once descending to 45 feet to urinate directly above me. This same female showed no response to natives talking at a distance. During the other two encounters the animals fled slowly, stopping intermittently to produce vocalizations and other sounds, and to throw branches to the ground.

Sounds—Sounds were emitted only when the animal was aware of my presence and presumably annoyed. Under similar circumstances Hornaday (1885) notes deep, guttural growls, and Wallace (1869) howling. Three types of sound were made interchangeably but continuously for 45 minutes by a female with large infant: (1) A smacking or kissing sound was made by tipping the head back, pursing the lips with the lower one protruding beyond the upper one and drawing the air in. Three times the female put the knuckles of one hand to her mouth and kissed them loudly. The kissing sound was usually followed by (2) a gluck-gluck-gluck that resembled loud gulping of liquid. The lips were pursed as above, and the throat moved as if she swallowed air. After the gulps the female produced several times a sound that can be best described as (3) a loud two-toned burp, starting on a long, low key to end on an abrupt higher note. These sounds were heard again during another encounter with a female and a male. Both gave the smacking sound, the male continuing it at the rate of once every few seconds for two hours. But only once did the male "gulp" and "burp."

Throwing of Branches—The fact that orang-utans may drop or throw branches if an observer stands beneath the tree has been recorded by Wallace (1869) and Attenborough (1957), although strangely neither Hornaday (1885) nor Beccari (1904) noted this behavior—probably because the animal was always shot before it had a chance to do so. I observed throwing of branches twice: (1) After fleeing from me for 40 minutes, a male stopped in a tree. He moved about and stepped on dry branches which broke off. Once he broke one off with the palm of his hand and watched the limb as it crashed to the ground. He also reached for branches around him, bent them until they snapped, wrenched them from the tree with a jerk, then threw them

downward. Half an hour later he hurled branches for 10 more minutes. (2) A female with a large infant spent 15 minutes throwing a total of about 30 branches varying in size from twigs to limbs ten feet long and three inches in diameter. Considerable effort was expended at times in tearing off the larger branches. Limbs were thrown in three ways: (a) she merely held the branch at her side and dropped it limply; (b) she looked down at me and swung the branch like a large pendulum, and at the peak of the arc closest to me she released it; (c) she lifted branches either as high as her chest or above her head with one hand and hurled them down forcefully. Whatever interpretation is given this behavior, there is no doubt that it induced me to jump nimbly at times and that it kept me effectively away from beneath the tree.

Summary

The distribution of the orang-utan encompasses the northern tip of Sumatra and extensive sections of Borneo. A two-month study in Sarawak, which comprises about ⅙ of Borneo, in all types of primary forest habitat, revealed that the orang-utan is limited in distribution to about 2,000 square miles and in number to not less than 450 and probably not more than 700 animals. Hunting has been the major cause for their decline in the past and habitat destruction threatens them at present in their major area of concentration. Preservation of the continuous tracts of primary forest still inhabited by orang-utans is essential if the small population of this ape is expected to survive. All hunting for meat and specimens, including live animals for zoos, must remain prohibited.

Behavior data is based on observations of 228 nests and four visual encounters for a total of 5¾ hours on eight animals. Orang-utans seldom descend to the ground. In the trees they are climbers, but brachiate on occasion. Groups number rarely more than four, and lone males and females are not infrequently encountered. Subadults appear to form their own group at times. There seems to be little group stability. Observations on a female with a small infant and a female with a large infant are described. Orang-utans are primarily frugivorous. Nests may be built nearly anywhere in a tree, but the majority are found 31 to 70 feet above ground. Basically the nest consists of three to nine branches broken in to form a platform and a lining of 0 to 34 twigs. A female built a crude nest in ten seconds. Reaction to man varies from immediate flight to seeming indifference. Sounds made by agitated animals can best be described as smacking, gulping, and burping. Throwing of branches while the observer stood near the tree was noted in two animals.

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